Open Radar Products Generator (ORPG) Common Operations and Development Environment (CODE) Utilization

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Overview

- **New Paradigm for WSR-88D Algorithm Development**

- **What is ORPG CODE? – An Overview**

- **Advantages of CODE**

- **Descriptions of CODE Versions**

- **Who is using CODE**

- **Accomplishments using CODE**

- **Future**

- **Backup Slides**
  - What is ORPG CODE, in Detail

New Paradigm for WSR-88D Algorithm Development

NPI Objective: Streamline technology transfer into the WSR-88D operational baseline by developing and evaluating radar applications in an Open RPG environment.

NPI Vision:

- WSR-88D applications are developed and evaluated by several organizations, using NPI CODE on Open RPG clones.

- Agency sponsored, mature applications are smoothly integrated into the WSR-88D baseline following an efficient well-defined process.

- Techniques development is decoupled from the software release cycle, allowing WSR-88D software containing greater functional improvements to be released more frequently.
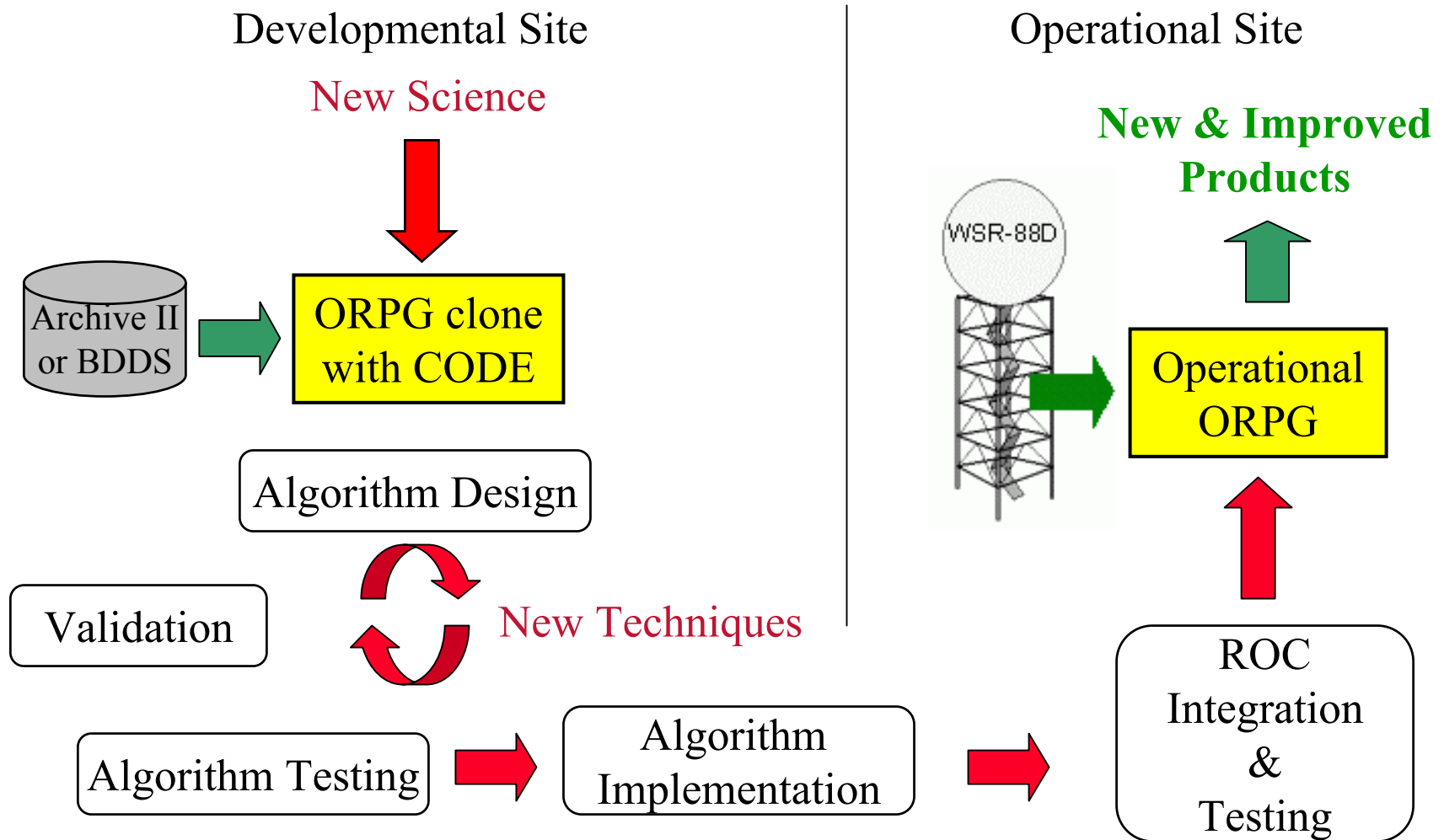
New Paradigm for WSR-88D Algorithm Development

Expectation: That new science can be inserted into the operational WSR-88D more frequently – as often as every 6 months

Purpose of CODE:

- Primary: To provide a development environment in support of WSR-88D algorithm implementation.

- Secondary: To provide a development environment supporting the research and development of WSR-88D algorithms.

Technology Transfer Process using ORPG CODE

Developmental Site

New Science

Archive II or BDDS → ORPG clone with CODE

Algorithm Design

Validation

New Techniques

Algorithm Testing → Algorithm Implementation →

Operational Site

New & Improved Products

WSR-88D

Operational ORPG

ROC Integration & Testing

What is CODE? – An Overview

- A WSR-88D Algorithm Development Environment
  - Modify and test existing legacy algorithms in FORTRAN
  - Create and test new algorithms in ANSI-C
- Installed on a single Ultra-Sparc workstation
- Includes a "clone" of an ORPG
  - Base data preprocessing & system infrastructure are identical to the operational system
  - Algorithms & products are identical to operational system
  - Does not control a radar
- Use the following data sources
  - Archive II data on 8 mm tape, disk, or CD-ROM
  - Live radar data via RPG Base Data Distribution Server (BDDS)
  - Live radar data via LDM/CRAFT Project

What is CODE? – An Overview (cont.)

CODE provides:

- A ROC CM release of ORPG source code

- Instructions to install, compile, & configure the ORPG

- CODE algorithm analysis and development utilities
  - Include data / product analysis display capability

- Extensive Guidance for Algorithm Developers
  - Configuration procedures to add new products / algorithm tasks
  - Reference for base data, final products structure
  - Algorithm adaptation data & product dependent parameter guide
  - Algorithm API reference (designated ORPG library services)
  - Algorithm structure guide (includes sample algorithms)

What is CODE? – An Overview (cont.)

Does NOT provide:

- A new Algorithm API or any Algorithm API service that is not part of the operational system

- Operational meteorological product display

- Documentation and guidance for system operation or system software maintenance

Advantages of CODE

- Algorithms developed on a clone are <u>easier for the ROC to integrate</u> into the operational ORPG
    - Use of certified API calls
    - Reuse of common functions

- With proper guidance, <u>algorithm DT&E testing</u> can be accomplished before submission to the ROC

- The <u>performance of the algorithm</u> can be evaluated before submission to the ROC with:
    - Workstation configured like the operational ORPG
    - Standard reference base data input stream provided
    - Standard process loading defined

Descriptions of CODE Versions
Developed for NPI, by Mitretek, under the direction of NWS/OS&T

- **CODE 2002 v1a**
  - Released in March 2002
  - Based on ORPG deployed build 1.1
- **CODE 2002 v2a**
  - Will be released in May 2002
  - Based on System Test version of ORPG build 2
- **CODE 2002 v3**
  - Will be released in June 2002
  - Major upgrade to CODEview text (CVT) and graphics(CVG)
    - Use alternate product database
    - Improvements in the display of digital products
    - Handles non-NEXRAD resolution products
    - Handles compressed products
    - Auto update
  - CODE documentation updated to reflect recent ORPG changes

Who is Using CODE - NWS

- **NWS**
  - **OS&T/Systems Engineering Center**
    - One baseline ORPG with backup clone (24/7 Sterling via BDDS) interfaced to 8 AWIPS, 1 via LAN interface
    - One AWIPS support clone (24/7 Wakefield via LDM/Craft) interfaced to 6 AWIPS, 1 via LAN interface
    - One OHD support & web display clone (24/7 Sterling)
    - Two ORPG development clones with playback or live data via Sterling or LDM/Craft
    - Implementing ORPG software
      - User Selectable Layer Reflectivity Product, Hodograph, Mesocyclone Rapid Update, Mesocyclone Detection Algorithm, TDWR and ARSR-4 FAA Radar Products

Who is Using CODE – NWS (cont.)

- **Office of Hydrologic Development**
  - One ORPG development clone with playback or live data via Sterling or LDM/Craft
  - Implementing ORPG software
    - Digital Storm Total Product, Radar/Gauge Bias clean-up, handle New VCPs, Range Correction Algorithm
- **OCWWS/Warning Decision Training Branch**
  - One ORPG with live data via LDM/Craft, 3 more clones planned
  - Switch around to different radars with interesting weather
  - Gain experience to develop Flash Flood Monitoring and Prediction(FFMP) training
  - Get early look at RPG builds for NEXRAD/AWIPS radar training development

Who is Using CODE - FAA

- **FAA (MIT/LL)**
  - Six field clones at ITWS prototype sites
    - Three at NY, and one each at Melbourne, Memphis, and Dallas/Ft. Worth
    - Five are getting live data via LDM, the other directly via BDDS
    - Demonstrating AP editing changes, HiVIL, and MIGFA (later this summer)
  - Four development clones with playback of live data via LDM/Craft
    - Two development, one integration, one demonstration
  - Implementing ORPG software
    - Artifacts Detection, Anomalous Propagation Editing, High Resolution VIL, MIGFA

Accomplishment Using CODE

NWS OST/SEC

– Composite Reflectivity with AP Removed

– ITWS Digital Base Velocity

– Base Data Array Products

– Radar Echo Classifier Algorithm

– Super Ob

– User Selectable Layer Composite Reflectivity

FAA MIT/LL

– Improved AP Edit Algorithm Adaptable Parameters

– High Resolution VIL

NWS OHD

– Radar/Gauge Bias Correction

Future Plans

- **ORPG Infrastructure Upgrades in Build 3, by ROC**
  - Operating System Upgrade to Solaris 8
    - Allows Sun Blade to be used as RPG clones
  - Common Compiler
    - Eliminates need for obsolete/unavailable Sun compilers
  - Port the ORPG to a PC Platform
    - Allows PC to be used as RPG clones
- **Possible future CODE Users**
  - TPC
  - NCAR
  - FSL
  - NSSL
  - USBR

Future (cont.)

- **CODE Evolution**
  - Binary distributions to allow partial ORPG compilation
  - Data Source Concepts
    - Common Level II datasets on CD-ROM
    - Ingest any of the three NCDC Level II formats
    - Capture live data, optionally compress, and store to disk
    - Extract selected times from data on disk and write to disk, tape, or CD-ROM
  - CODEview Text and Graphics
    - Extensions to support other options to facilitate testing and product display
    - Display intermediate buffer formats
  - Support adaptable parameter sensitivity studies
  - Adaptable parameter support
  - Task/buffer configuration support

BACKUP SLIDES

What is CODE, in Detail

- What's in CODE?
  - **Overview**
  - **Software for the ORPG Clone**
  - **CODE Software**
  - **CODE Guide Volumes 1, 2, 3, 4**
  - **CODE Utilities**
    - **CODEview Text (CVT)**
    - **CODEview Graphics (CVG)**
    - **Archive II Disk File Utilities**
  - **Future Changes in CODE**
  - **How is CODE Packaged**

What's in CODE? – In Detail

Basic Development Tools

- Compilers, linkers, etc.
- Debugging Tools
- Documentation tools

NEXRAD Specific Tools
- WSR-88D Data & Product Display
- Test Tools
- Other

ORPG Clone on Desktop Workstation

WSR-88D Algorithm API

Documentation & Guidance
- Vol 1 Installation & Configuration Guide
- Vol 2 Algorithm Development Guide
    Compiling Software
    Configuring ORPG for new Algorithms
- Vol 3 Algorithm API Reference

Guidance for Formal Integration
- Vol 4 Algorithm Delivery Package
    ANSI C Coding Standards
    Documentation & Test Requirements

What's In CODE?
Software for the ORPG Clone

- CODE Provides
  - **Complete ORPG source code (ROC CM controlled release)**
    - `ORPG Build 2 (release 1.1)`
  - **Required GNU compilers & tools**
    - `GCC 2.95.2 & GNU make 2.78`

- Not Provided
  - Sun Ultra-5 / Ultra-10 workstation (Solaris 7)
  - Sun compilers
  - Base data source*

* software to read Archive II from 8mm tape / disk files and to receive BDDS on a LAN is provided. However, software to ingest data via the CRAFT project is available separately from OST/SEC.

What's In CODE?
CODE Software

- ## Sample Algorithms
  - **currently 4 are provided**
- ## CODE Utilities
  - **CODEview Text (`CVT`)**
  - **CODEview Graphics (`CVG`)**
  - **Archive II Disk file Utilities (`ar2disk` & `play_ar2`)**
  - **Additional Tools (Site adapt data, background maps, etc)**
- ## Installation Instructions for all of the above

```
Sample algorithms – 240 KB files (4135 lines of code)
Major applications*:  CVT – 155 KB files (3640 lines of code)
          CVG – 542 KB files (13,600 lines of code) plus
                42 KB of preference / configuration files
              750 KB of third party libraries
     * approx 4% of ORPG source code
```

What's In CODE?
CODE Software cont.

- Software Requisites
  - `Perl` **Interpreter &** `BZIP2` **(for Archive II Disk file)**
  - `ZLIB` **(compression lib) &** `PNG` **lib (for** `CVG`**)**
- Installation Instructions for all of the above

What's In CODE?
CODE Guide Volume 1

- **ORPG Clone Installation Instructions**
  - System Administration Prerequisites & System Requirements
  - Account Configuration
  - Compiling ORPG
  - Configuration of ORPG

- **Running the ORPG**

- Primarily HTML documentation: approximately 49 pages when printed
- Other files:
  - 1 modified script
  - 2 modified global makefiles
  - 3 modified makefiles
  - 6 modified configuration files
  - 8 account environment configuration files

What's In CODE?
CODE Guide Volume 2

- ## Instructions for
  - Integrating new development source code
  - Using ORPG makefiles & compiling new algorithms
  - Configuration of ORPG for new algorithms
  - Creating and installing algorithm adaptation data

- ## Information & Guidance
  - ORPG SW architecture
  - WSR-88D Base data structure & Final Product Structure
  - Algorithm Product Dependent Parameters

- `Primarily HTML documentation:   approximately 82 pages when printed`
- `4 PDF files: 15 pages`
- `Other files:`

What's In CODE?
CODE Guide Volume 3

- ORPG Algorithm API reference
- Guidance for
  - Using the ORPG algorithm API
  - Structure of algorithms
- Documentation of the Sample Algorithms
- Documentation of the CODE Development Utilities
  - CODEview Text
  - CODEview Graphics
  - Archive II Disk File Utilities

- Primarily HTML documentation: approximately 108 pages when printed
- 2 PDF files: 5 pages
- Other files: 45 pages

What's In CODE?
CODE Guide Volume 4

- NEXRAD Agency Guidance for the Algorithm Delivery Package

  – ANSI-C Coding Standards

  – Documentation Requirements

  – Development Testing Requirements

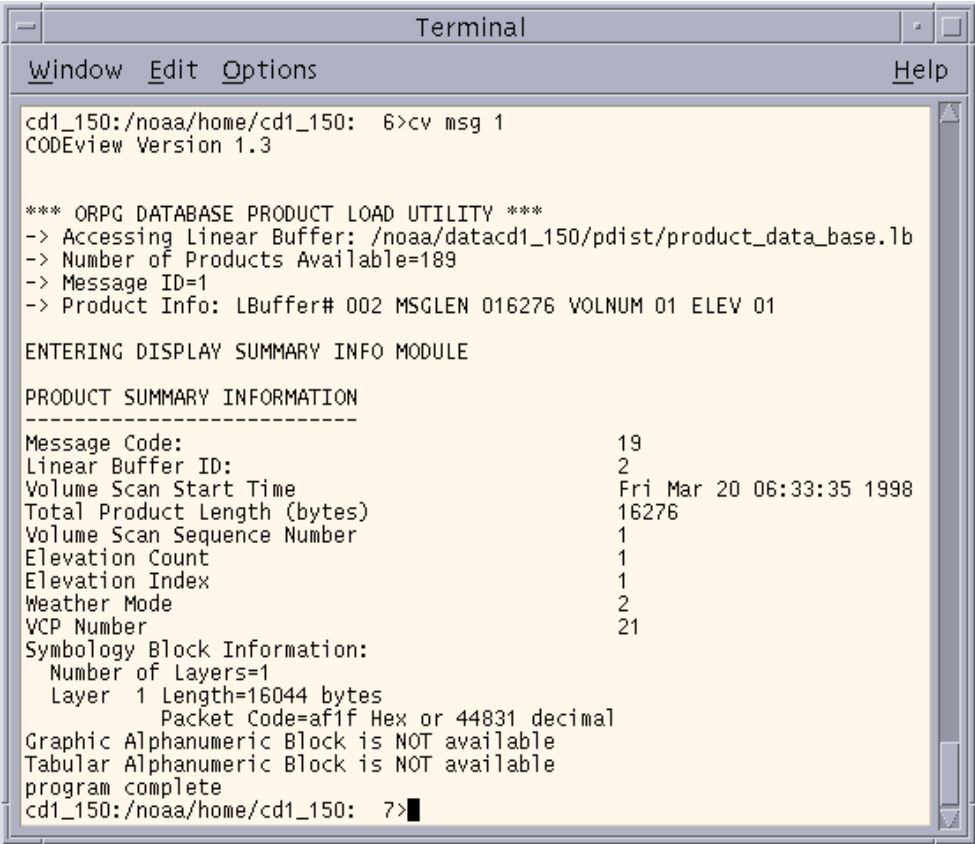# Code Utilities-
CODEview Text (CVT)

Final product analysis tool

- View final product header and data packets in text format

- View RLE data either decoded (Decimal) or encoded (Hex)

Linear buffer inventory function

Extract final product to a file, either to a binary image or to ASCII text

Extract intermediate product to a file, either to a binary image or to ASCII

```
Terminal

Window   Edit   Options                                    Help

cd1_150:/noaa/home/cd1_150:  6>cv msg 1
CODEview Version 1.3


*** ORPG DATABASE PRODUCT LOAD UTILITY ***
-> Accessing Linear Buffer: /noaa/datacd1_150/pdist/product_data_base.lb
-> Number of Products Available=189
-> Message ID=1
-> Product Info: LBuffer# 002 MSGLEN 016276 VOLNUM 01 ELEV 01

ENTERING DISPLAY SUMMARY INFO MODULE

PRODUCT SUMMARY INFORMATION
---------------------------
Message Code:                          19
Linear Buffer ID:                      2
Volume Scan Start Time                 Fri Mar 20 06:33:35 1998
Total Product Length (bytes)           16276
Volume Scan Sequence Number            1
Elevation Count                        1
Elevation Index                        1
Weather Mode                           2
VCP Number                             21
Symbology Block Information:
  Number of Layers=1
  Layer  1 Length=16044 bytes
         Packet Code=af1f Hex or 44831 decimal
Graphic Alphanumeric Block is NOT available
Tabular Alphanumeric Block is NOT available
program complete
cd1_150:/noaa/home/cd1_150:  7>█
```
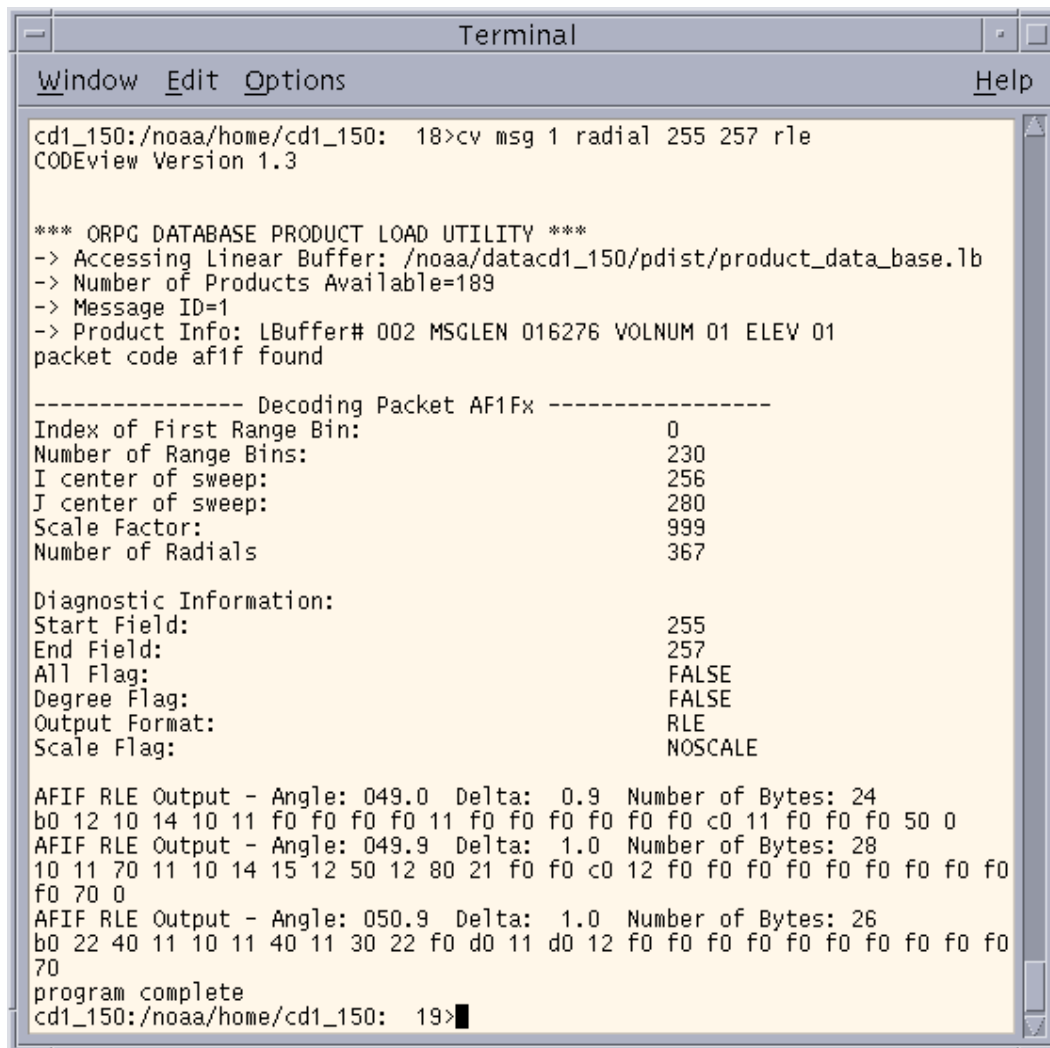
Code Utilities- CODEview Text (CVT)

Example product data display

Displaying radial 255 through 257 of a base reflectivity product, with the option to NOT decode (still run length encoded)

```
Terminal                                    Help
Window  Edit  Options

cd1_150:/noaa/home/cd1_150:  18>cv msg 1 radial 255 257 rle
CODEview Version 1.3


*** ORPG DATABASE PRODUCT LOAD UTILITY ***
-> Accessing Linear Buffer: /noaa/datacd1_150/pdist/product_data_base.lb
-> Number of Products Available=189
-> Message ID=1
-> Product Info: LBuffer# 002 MSGLEN 016276 VOLNUM 01 ELEV 01
packet code af1f found

--------------- Decoding Packet AF1Fx ----------------
Index of First Range Bin:                    0
Number of Range Bins:                        230
I center of sweep:                           256
J center of sweep:                           280
Scale Factor:                                999
Number of Radials                            367

Diagnostic Information:
Start Field:                                 255
End Field:                                   257
All Flag:                                    FALSE
Degree Flag:                                 FALSE
Output Format:                               RLE
Scale Flag:                                  NOSCALE

AFIF RLE Output - Angle: 049.0  Delta:  0.9  Number of Bytes: 24
b0 12 10 14 10 11 f0 f0 f0 f0 11 f0 f0 f0 f0 f0 f0 c0 11 f0 f0 f0 50 0
AFIF RLE Output - Angle: 049.9  Delta:  1.0  Number of Bytes: 28
10 11 70 11 10 14 15 12 50 12 80 21 f0 f0 c0 12 f0 f0 f0 f0 f0 f0 f0 f0
f0 70 0
AFIF RLE Output - Angle: 050.9  Delta:  1.0  Number of Bytes: 26
b0 22 40 11 10 11 40 11 30 22 f0 d0 11 d0 12 f0 f0 f0 f0 f0 f0 f0 f0 f0
70
program complete
cd1_150:/noaa/home/cd1_150:  19>
```
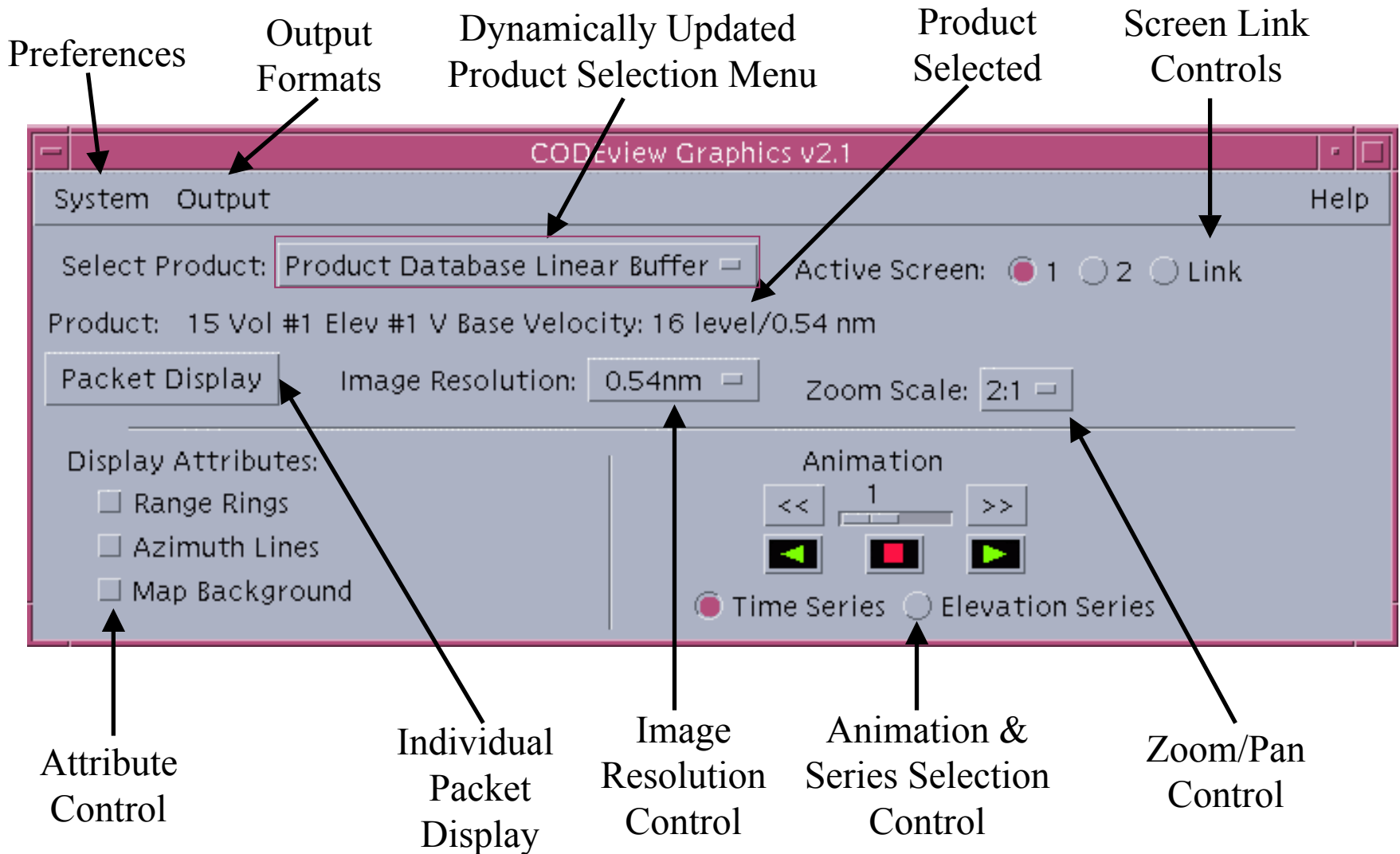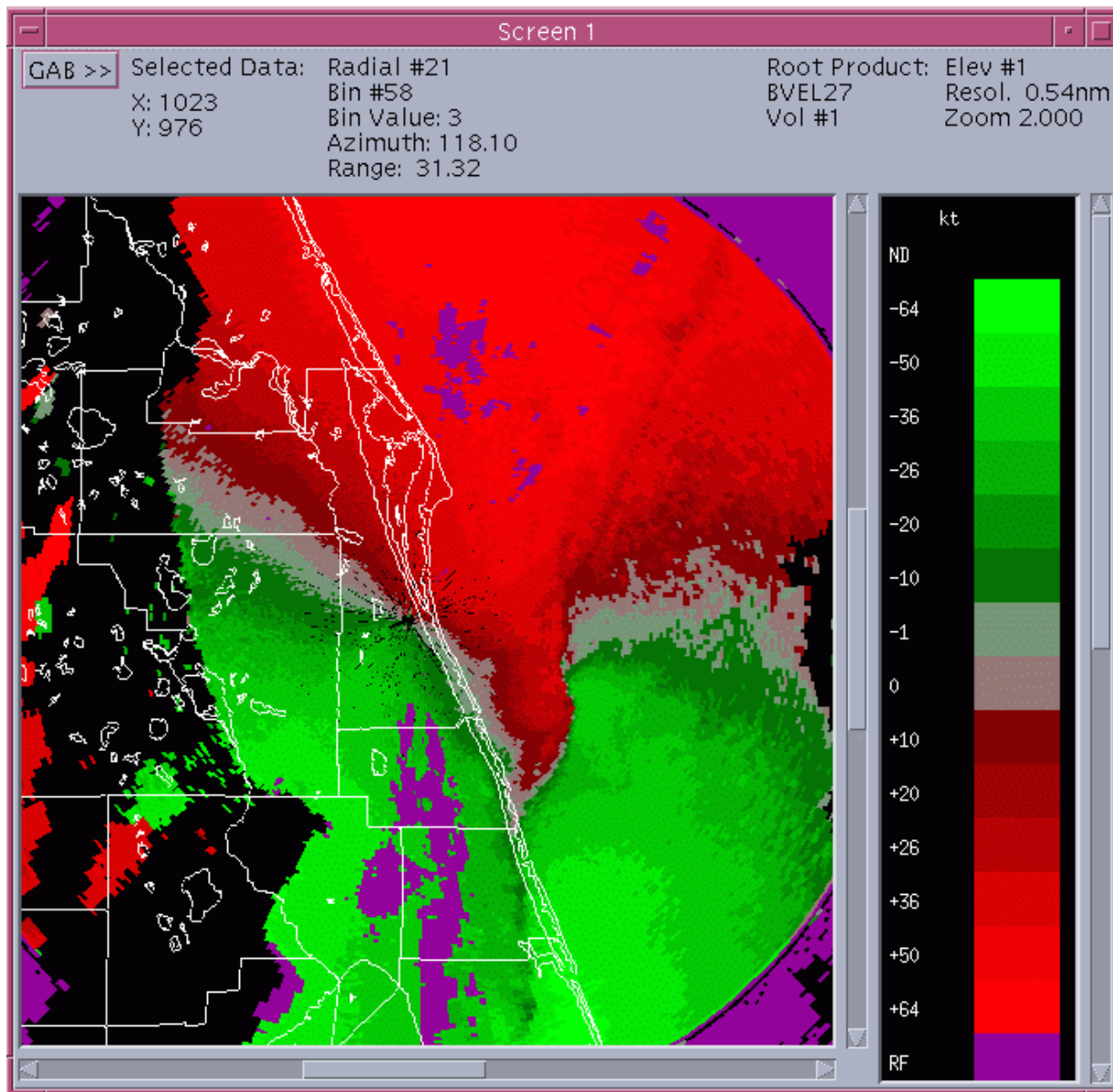
Code Utilities-
CODEview Graphics (CVG)

- A Graphical analysis tool NOT an operational display

- Displays
  - ICD compliant final products (both graphical & alpha)
  - CVG-specific intermediate structures for polar and Cartesian data sets

- Decodes the product (can display new products if they follow the ICD)

The CVG Main GUI

Preferences

Output Formats

Dynamically Updated Product Selection Menu

Product Selected

Screen Link Controls

CODEview Graphics v2.1

System   Output   Help

Select Product: Product Database Linear Buffer ⊟   Active Screen: ⦿ 1 ○ 2 ○ Link

Product: 15 Vol #1 Elev #1 V Base Velocity: 16 level/0.54 nm

Packet Display   Image Resolution: 0.54nm ⊟   Zoom Scale: 2:1 ⊟

Display Attributes:
☐ Range Rings
☐ Azimuth Lines
☐ Map Background

Animation
1
<<   >>
◄   ■   ►
⦿ Time Series ○ Elevation Series

Attribute Control

Individual Packet Display

Image Resolution Control

Animation & Series Selection Control

Zoom/Pan Control

CVG display of base velocity zoomed 2:1 with map background.

The left-click data sampling output can be seen along the top.

Linked Screens

CVG offers the ability to display 2 screens independently or linked.

The linkage allows for the simultaneous sampling of values on the screen, movement of the canvas, or looping.

A left click anywhere on the digital canvas provides a readout of the cursor location, data bin and value.
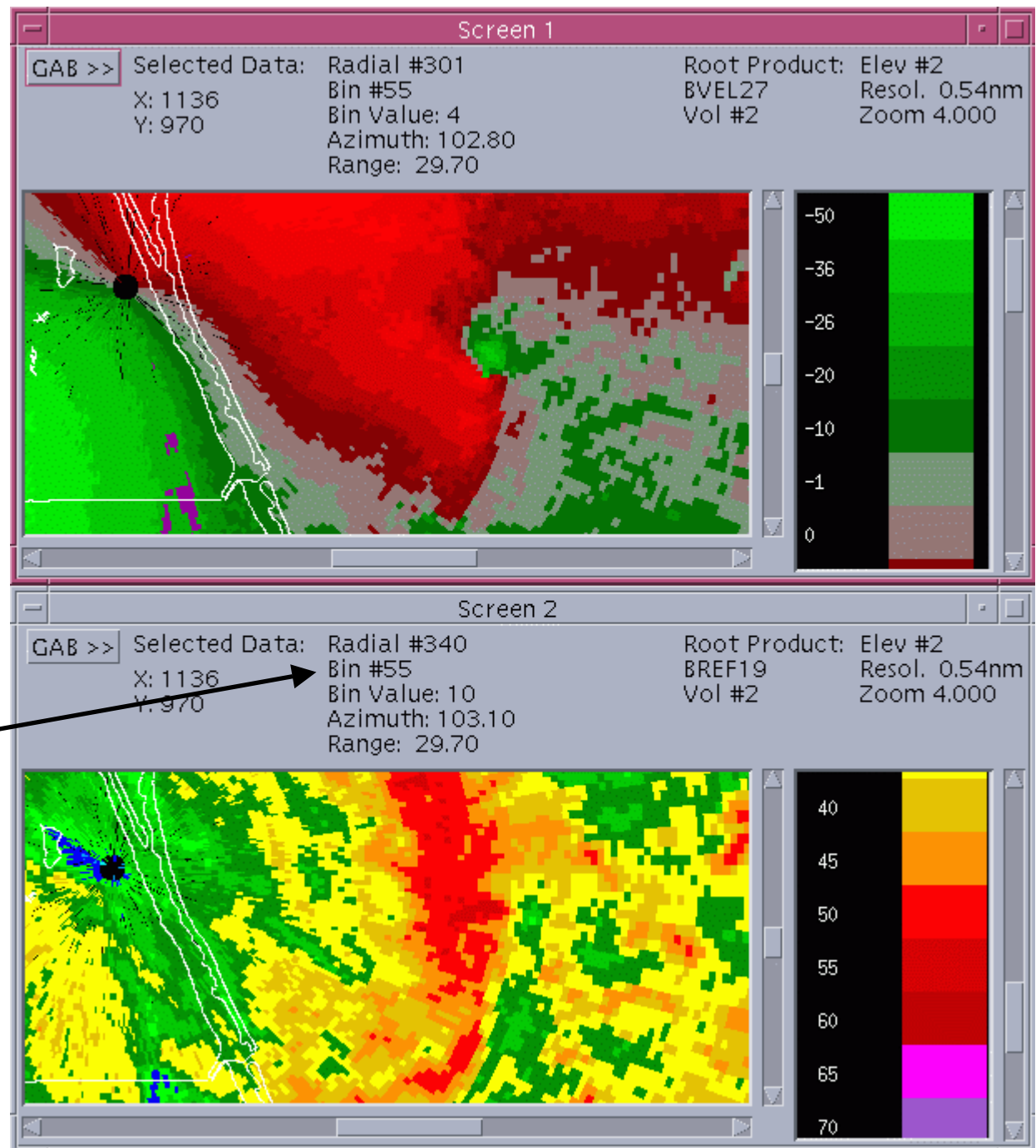
Code Utilities-
Archive II Disk File Utilities

- **ar2disk** utility
  - Creates disk files from 8mm Archive II Data tapes
  - Each file contains a volume of data
  - Disk files can be arranged in a directory structure for test case data

- **play_ar2** utility
  - Reads disk files of Archive II data & ingests into ORPG clone
  - Reads files in "time-stamp" order or order determined by a play list.
  - Command line options provide flexibility for development & testing
    - Directory to read from, first file, & number of files
    - Read files from a play list
    - One time or continuous play
    - Relative play back speed

Future Changes in CODE

- Complete CODE Guide Volume 4: NEXRAD Agency Guidance for preparation of Algorithms for handoff to the ROC

- Additional ORPG Algorithm API Enhancements including:
  - Simplified algorithm structure from
    - option to read base data via whole elevations in addition to individual radial messages
    - improved support for ICD graphic product assembly (e.g., data packet construction)
  - Standard data structures for elevations and volumes
    - promotes the creation of libraries of reusable scientific and data manipulation functions (Common Calculations)

Future Changes – Layered API Services
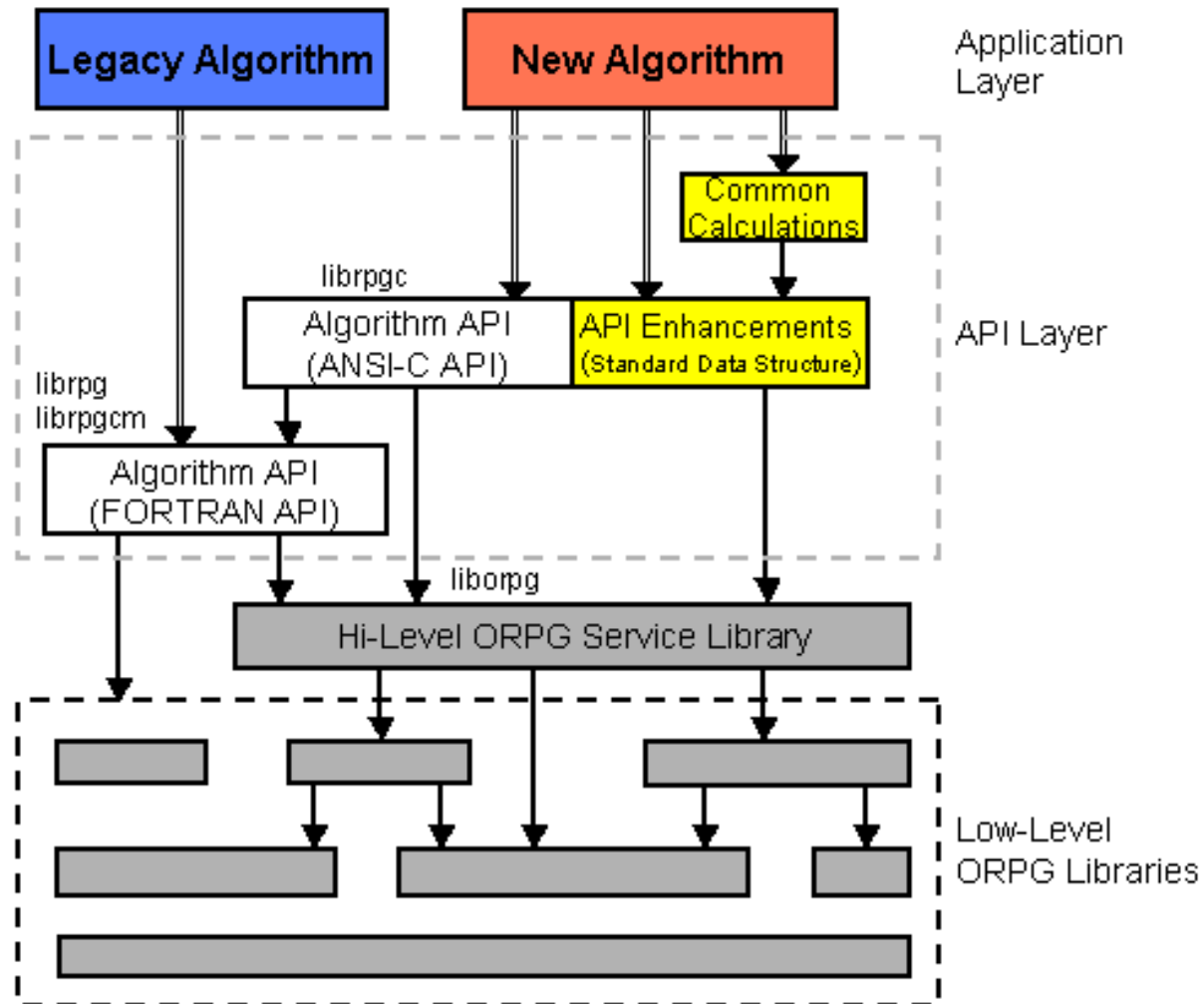
Future Changes in CODE

- Prepare CODE distribution that is not dependent upon Sun Compilers that can no longer be purchased.

- Additional Sources for Base Data

And others

Overview of CODE –
How is CODE Packaged

- NWS CODE is distributed on a CD-ROM
  - Extracted archive includes HTML documentation in the form of a Web Site and all software except the Sun Language Compilers and the Solaris operating system.
  - Currently limited distribution controlled by the NPI Development Manager

- To obtain a copy of ORPG CODE, contact:
  - Mike Istok, NPI Development Manager
  - Michael.Istok@noaa.gov

- Future distribution will be via CODE download site at Unidata

- CODE User List Server (NEXRAD agency sponsored users) http://infolist.nws.noaa.gov/scripts/lyris.pl?enter=ORPG_CODE_help